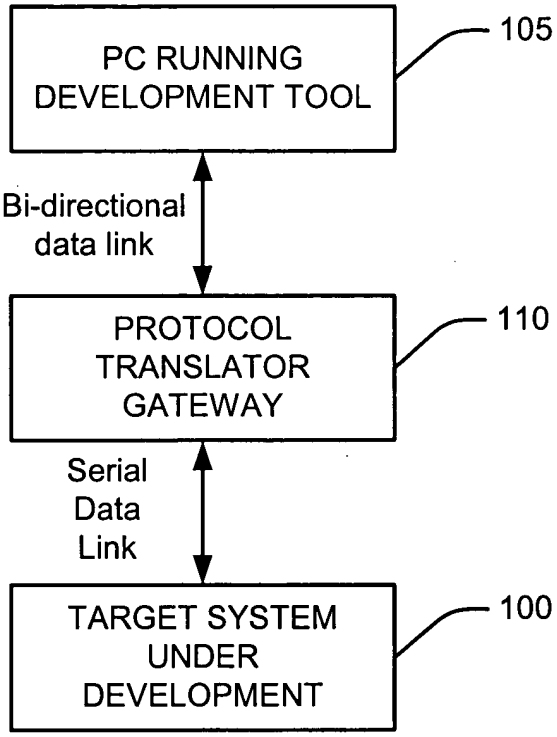
PC RUNNING DEVELOPMENT TOOL
105
Bi-directional data link
PROTOCOL TRANSLATOR GATEWAY
110
Serial Data Link
TARGET SYSTEM UNDER DEVELOPMENT
100

FIG. 1

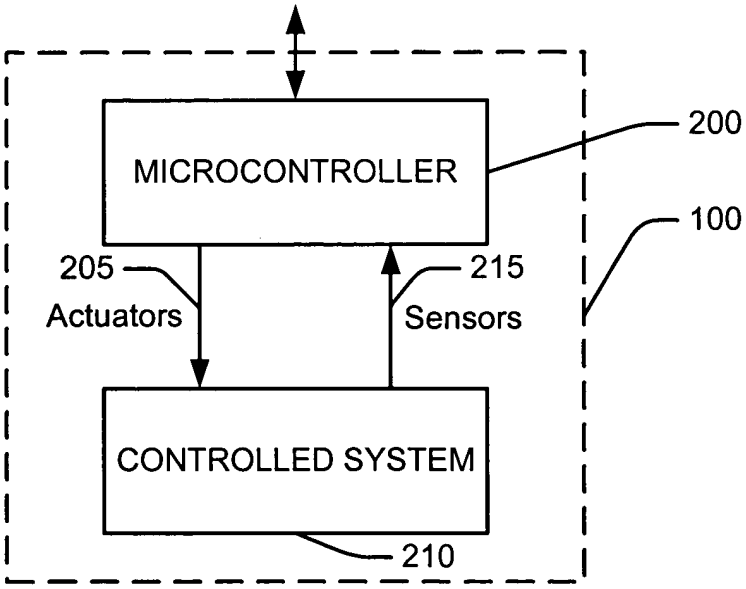
MICROCONTROLLER
200
100
205
Actuators
215
Sensors
CONTROLLED SYSTEM
210

FIG. 2

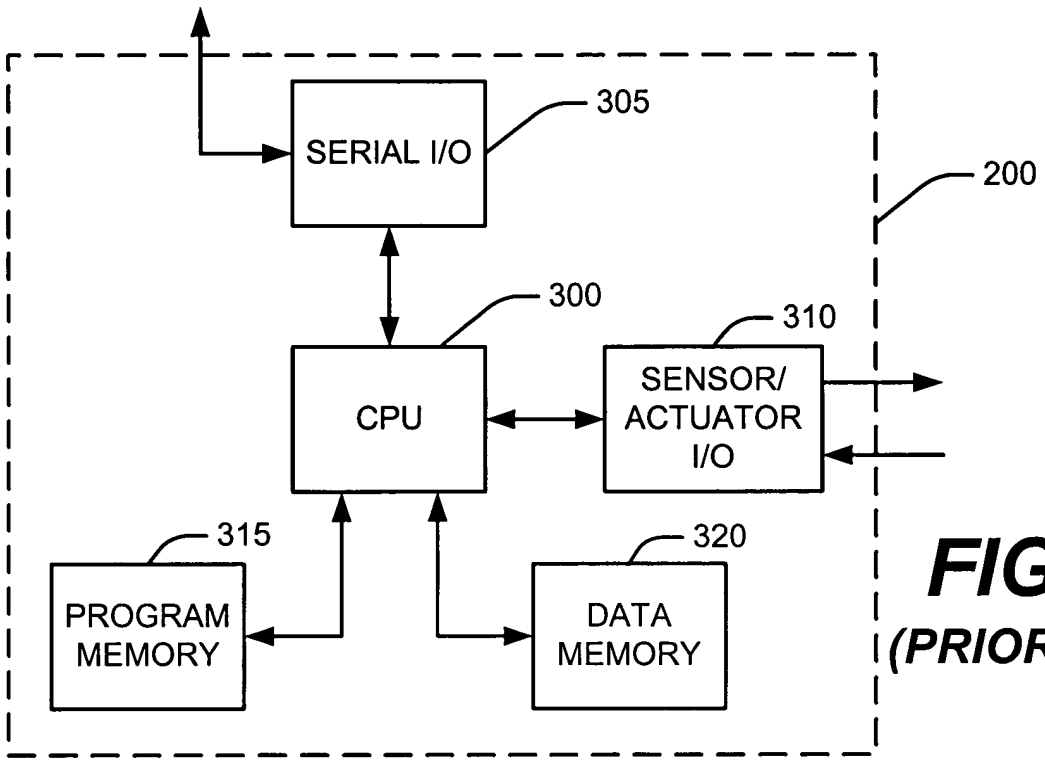

FIG. 3
(PRIOR ART)

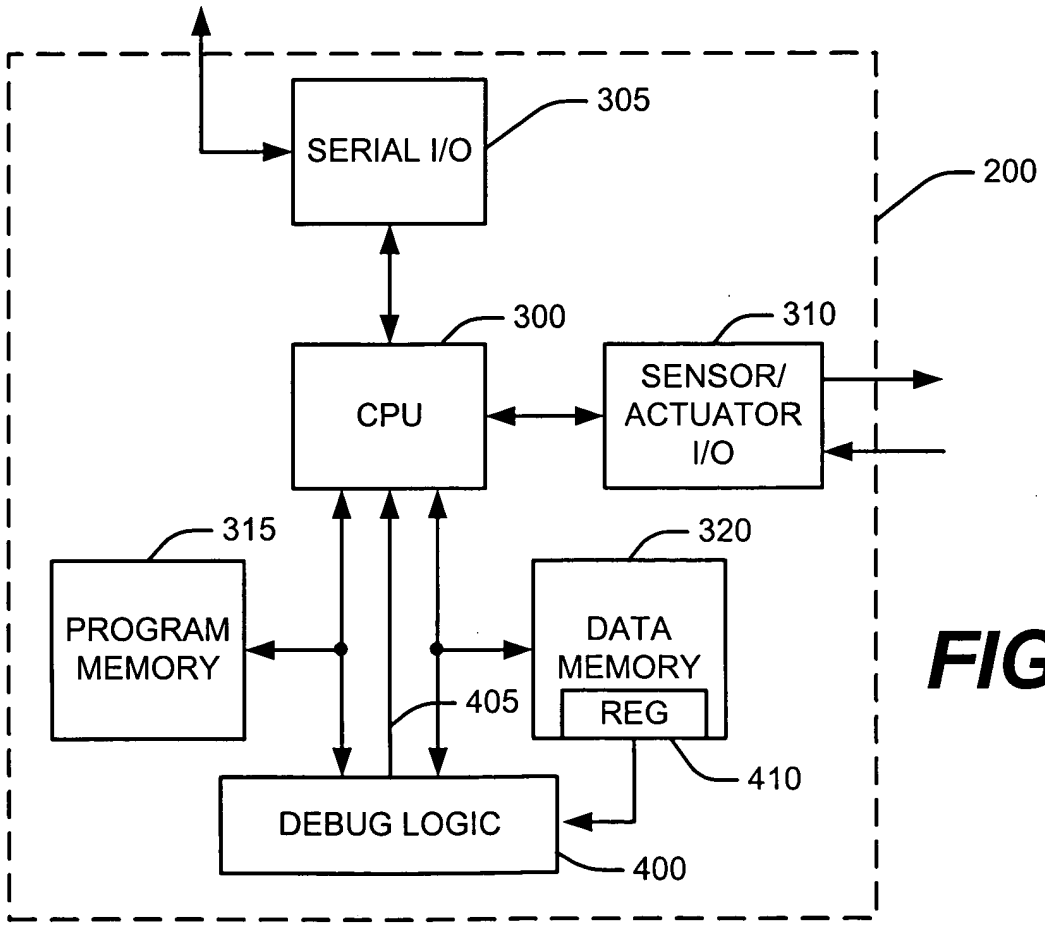

FIG. 4

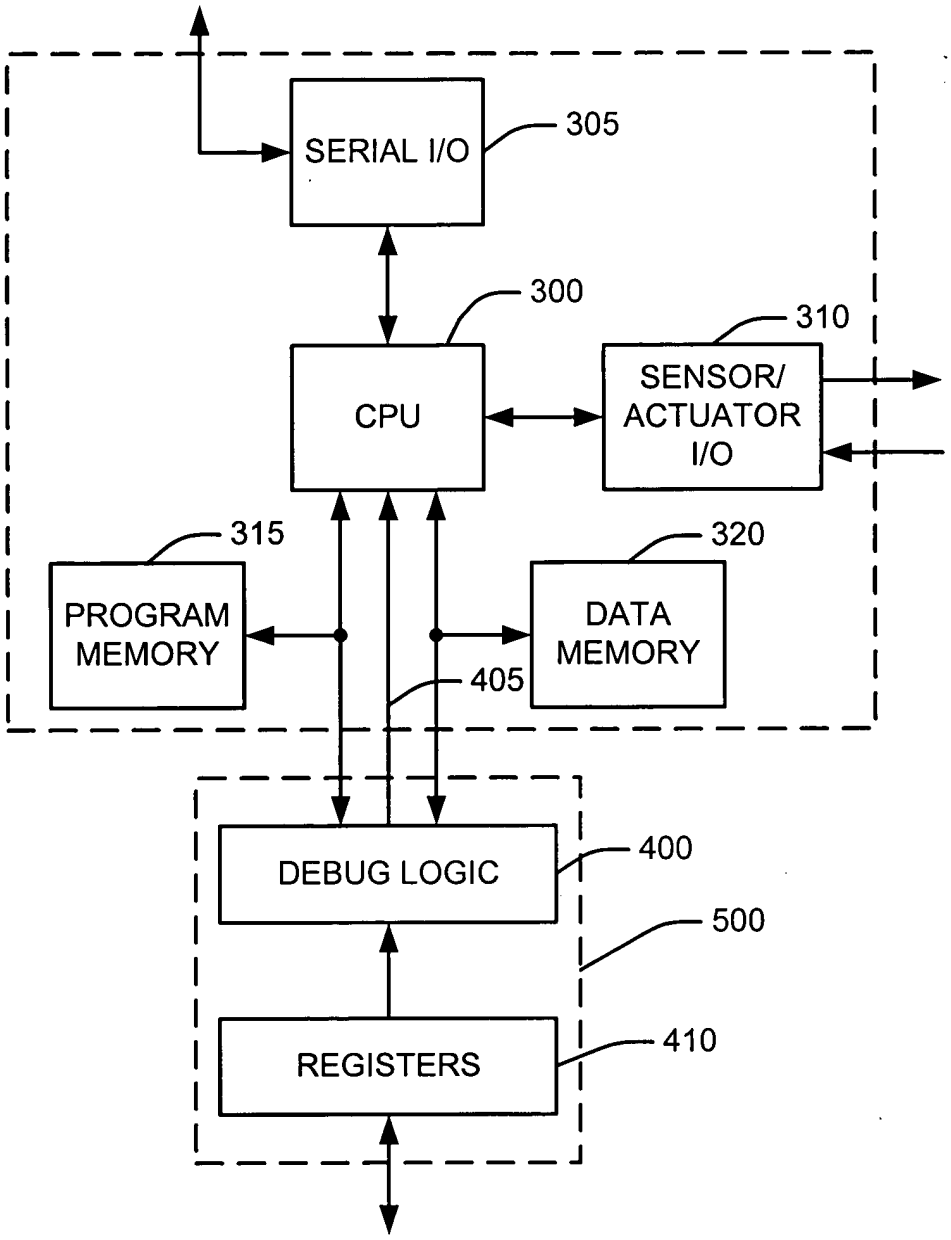
SERIAL I/O
305
300
CPU
310
SENSOR/
ACTUATOR
I/O
315
PROGRAM
MEMORY
320
DATA
MEMORY
405
DEBUG LOGIC
400
500
REGISTERS
410

FIG. 5

DEBUG REGISTER

INBUG	FREEZ	SSTEP	SHDW	BRB7	BRB6	BTRIS7	BTRIS6

600

ICKBUG REGISTER

PPDAT	DATRW	DCMP	Stkbrk	BKA19	BKA18	BKA17	BKA16

605

A B C

BITS 16-19 OF BREAKPOINT ADDRESS REGISTER

BIGBUG REGISTER

BKA15	BKA14	BKA13	BKA12	BKA11	BKA10	BKA09	BKA08

610

BITS 15-8 OF BREAKPOINT ADDRESS REGISTER

GLOBUG REGISTER

BKA07	BKA06	BKA05	BKA04	BKA03	BKA02	BKA01	BKA00

615

BITS 7-0 OF BREAKPOINT ADDRESS REGISTER
BITS 7-0 OF BREAKPOINT DATA REGISTER

CNTBUG REGISTER

BKC07	BKC06	BKC05	BKC04	BKC03	BKC02	BKC01	BKC00

620

BITS 7-0 OF BREAKPOINT COUNT REGISTER

SLGBUG REGISTER

-	-	-	-	-	-	-	RSBUG

625

FIG. 6

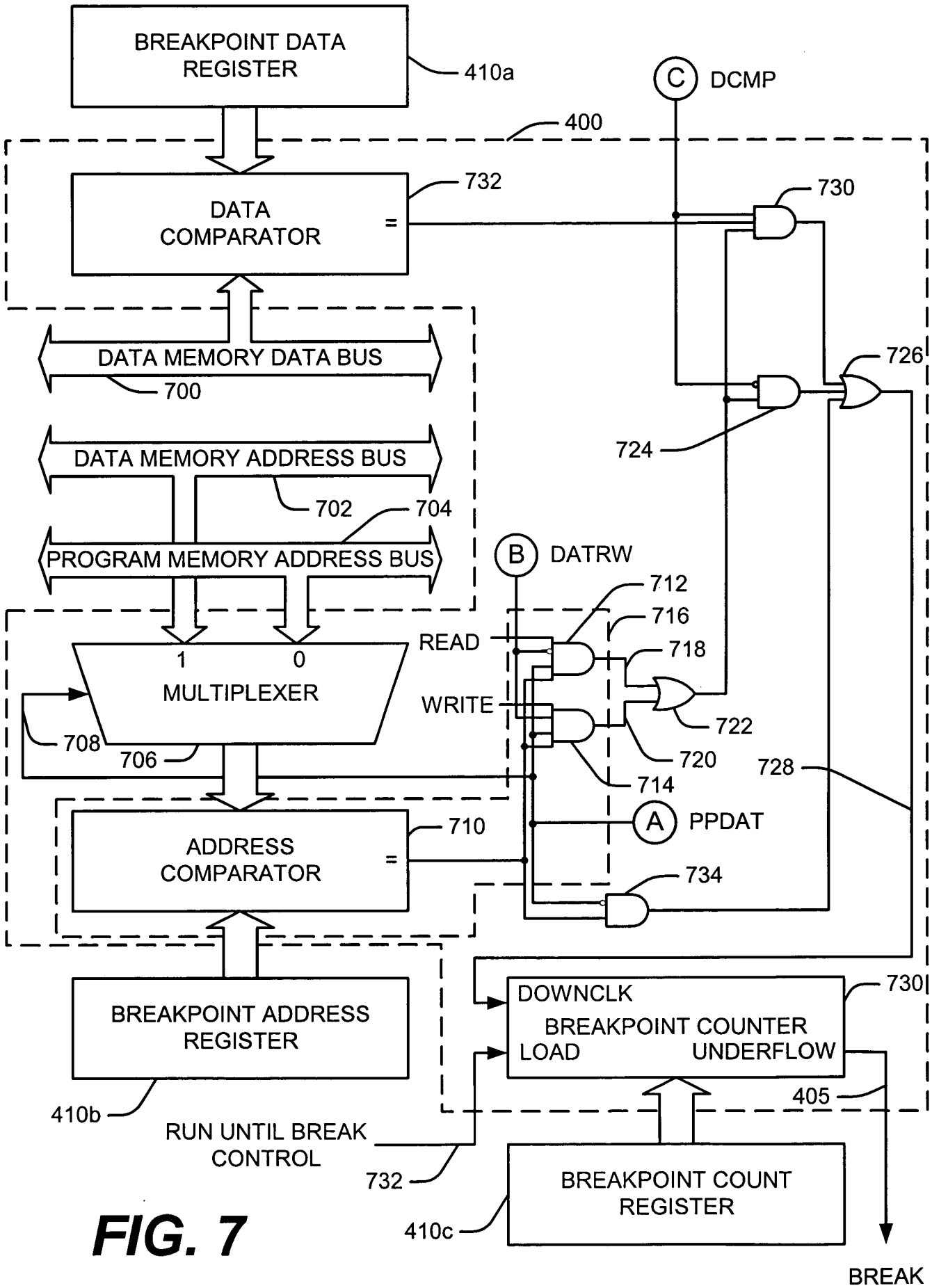
BREAKPOINT DATA REGISTER
410a
C
DCMP
400
DATA COMPARATOR
=
732
730
DATA MEMORY DATA BUS
700
726
724
DATA MEMORY ADDRESS BUS
702
704
PROGRAM MEMORY ADDRESS BUS
B
DATRW
712
716
READ
718
1
0
MULTIPLEXER
WRITE
722
708
706
720
728
714
A
PPDAT
ADDRESS COMPARATOR
=
710
734
BREAKPOINT ADDRESS REGISTER
DOWNCLK
BREAKPOINT COUNTER
LOAD
UNDERFLOW
730
405
410b
RUN UNTIL BREAK CONTROL
732
BREAKPOINT COUNT REGISTER
410c
BREAK

FIG. 7

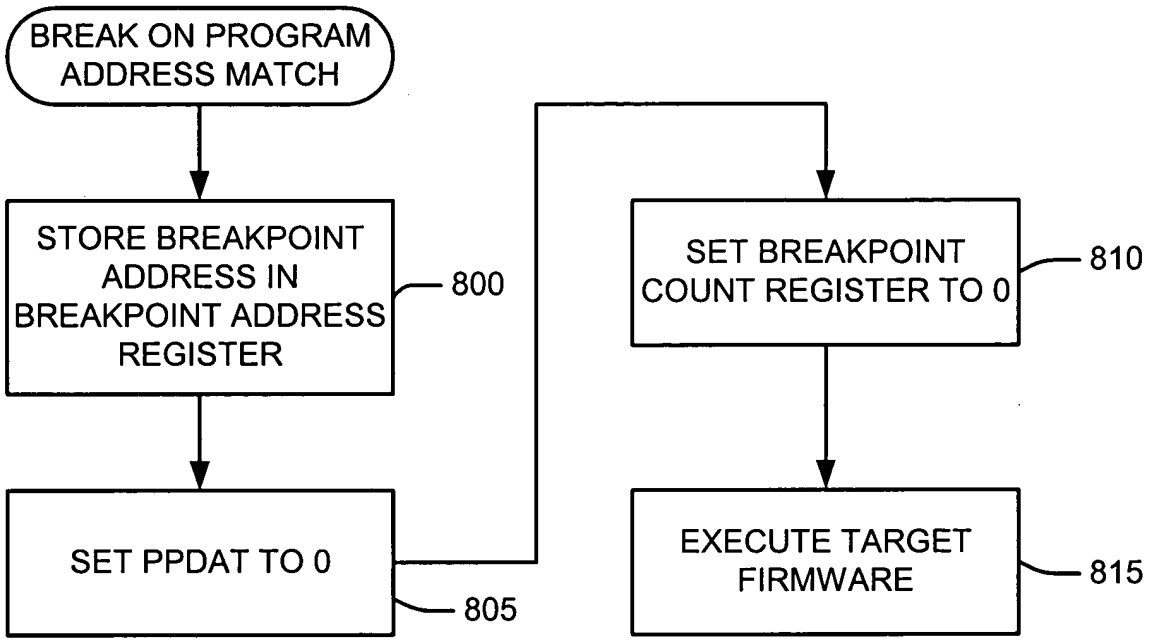
BREAK ON PROGRAM ADDRESS MATCH
STORE BREAKPOINT ADDRESS IN BREAKPOINT ADDRESS REGISTER
800
SET PPDAT TO 0
805
SET BREAKPOINT COUNT REGISTER TO 0
810
EXECUTE TARGET FIRMWARE
815

FIG. 8

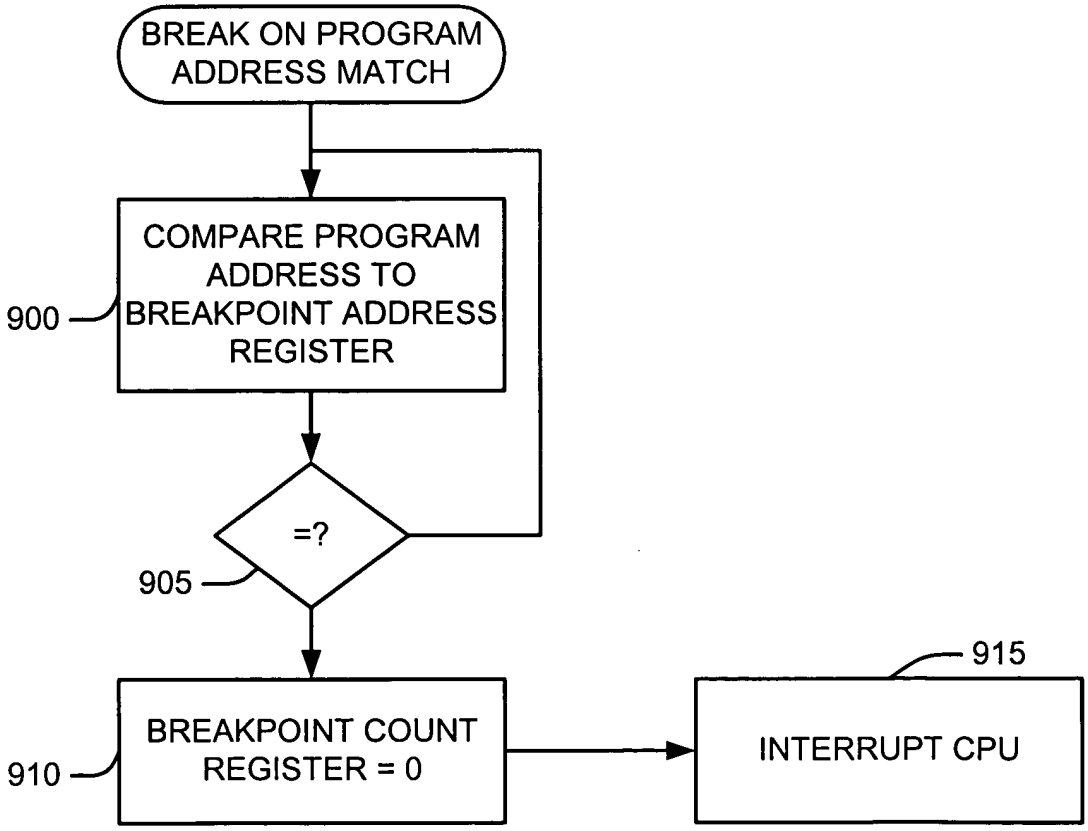
BREAK ON PROGRAM ADDRESS MATCH
COMPARE PROGRAM ADDRESS TO BREAKPOINT ADDRESS REGISTER
900
=?
905
BREAKPOINT COUNT REGISTER = 0
910
INTERRUPT CPU
915

FIG. 9

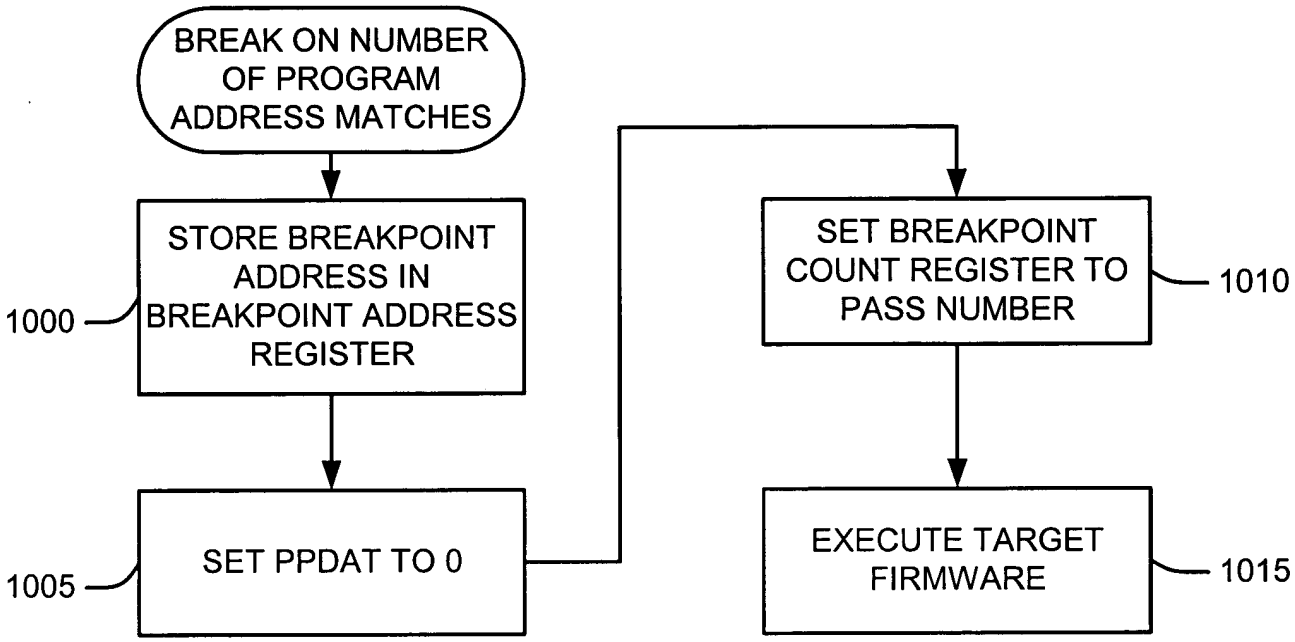
BREAK ON NUMBER OF PROGRAM ADDRESS MATCHES
STORE BREAKPOINT ADDRESS IN BREAKPOINT ADDRESS REGISTER
1000
SET PPDAT TO 0
1005
SET BREAKPOINT COUNT REGISTER TO PASS NUMBER
1010
EXECUTE TARGET FIRMWARE
1015

FIG. 10

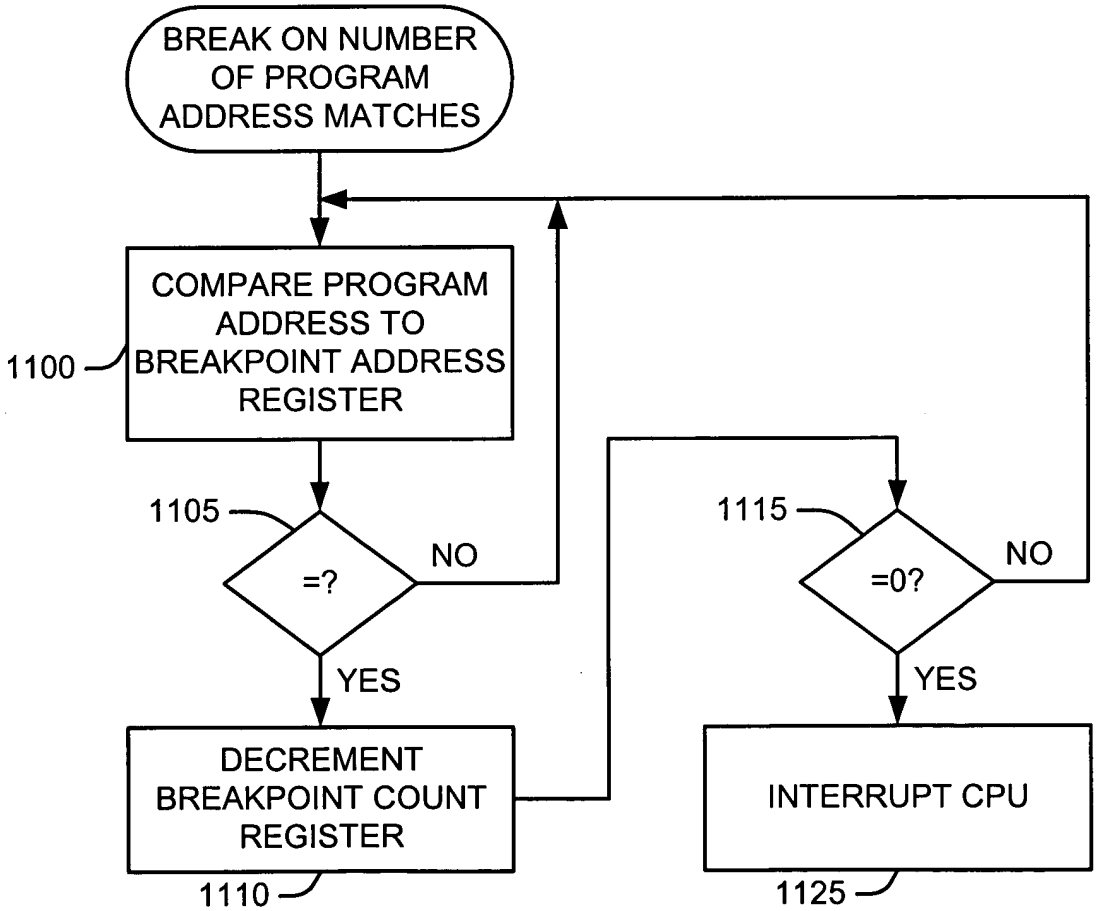
BREAK ON NUMBER OF PROGRAM ADDRESS MATCHES
COMPARE PROGRAM ADDRESS TO BREAKPOINT ADDRESS REGISTER
1100
1105
=?
NO
YES
DECREMENT BREAKPOINT COUNT REGISTER
1110
1115
=0?
NO
YES
INTERRUPT CPU
1125

FIG. 11

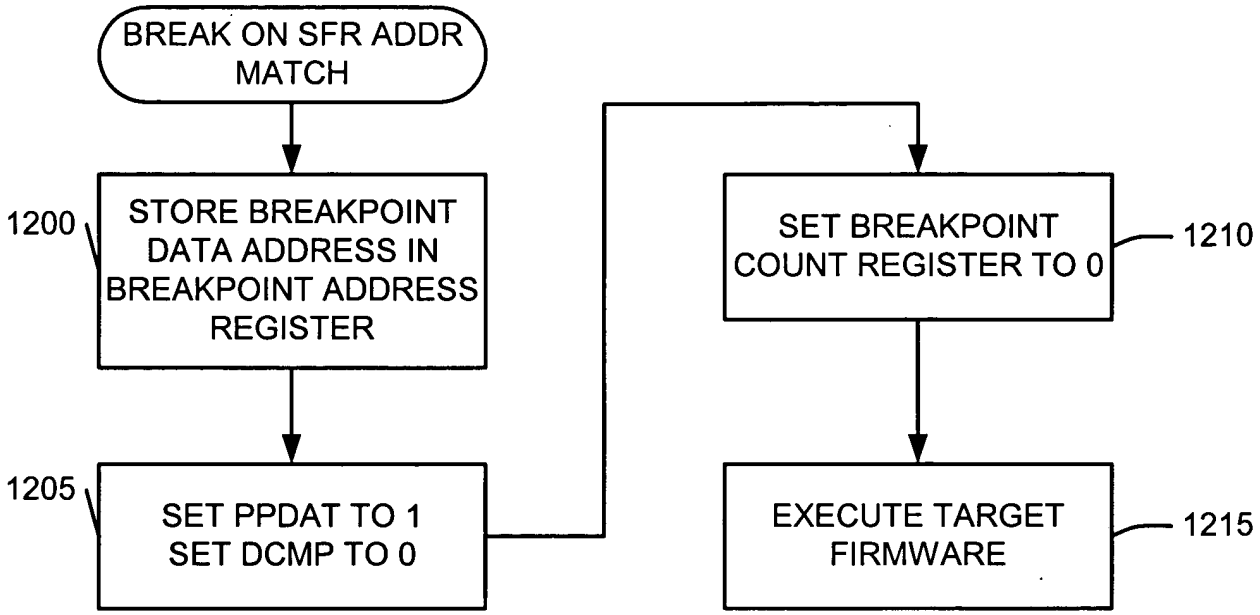
BREAK ON SFR ADDR MATCH
1200
STORE BREAKPOINT DATA ADDRESS IN BREAKPOINT ADDRESS REGISTER
1205
SET PPDAT TO 1
SET DCMP TO 0
SET BREAKPOINT COUNT REGISTER TO 0
1210
EXECUTE TARGET FIRMWARE
1215

FIG. 12

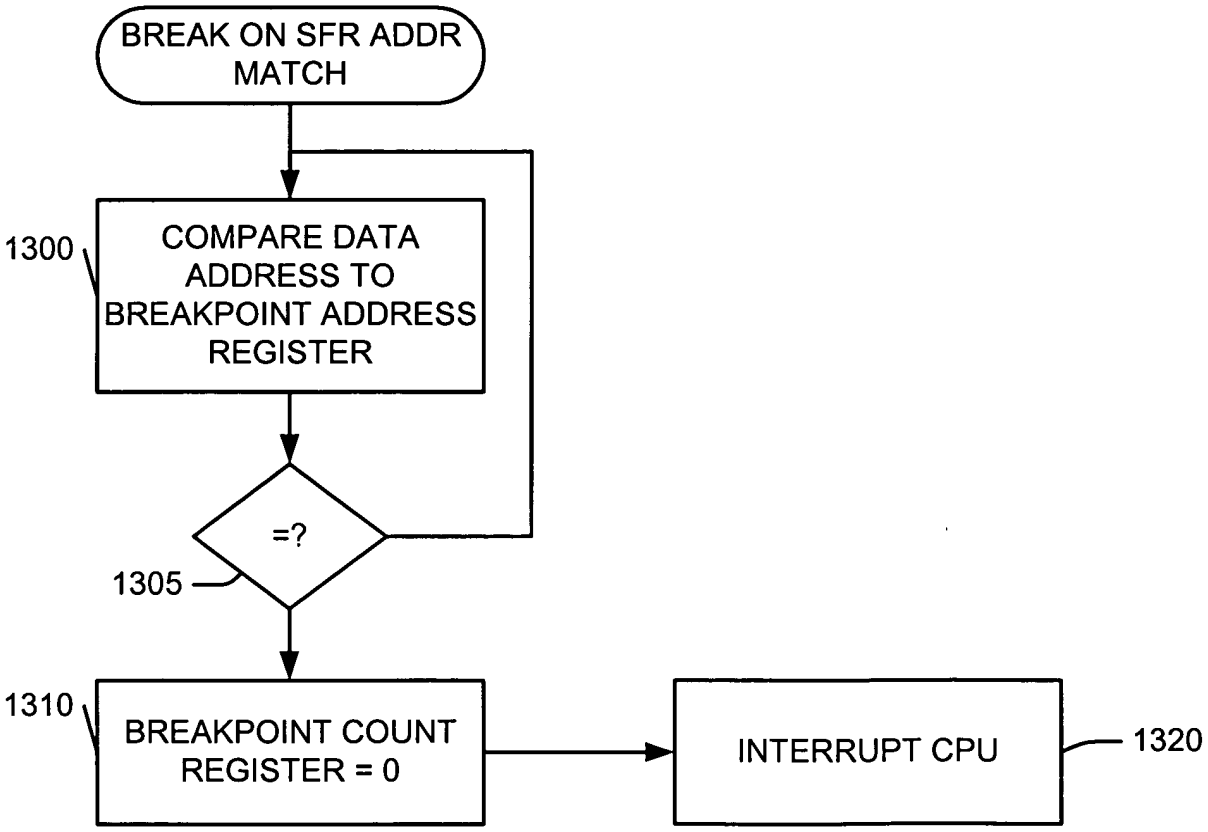
BREAK ON SFR ADDR MATCH
1300
COMPARE DATA ADDRESS TO BREAKPOINT ADDRESS REGISTER
=?
1305
1310
BREAKPOINT COUNT REGISTER = 0
INTERRUPT CPU
1320

FIG. 13

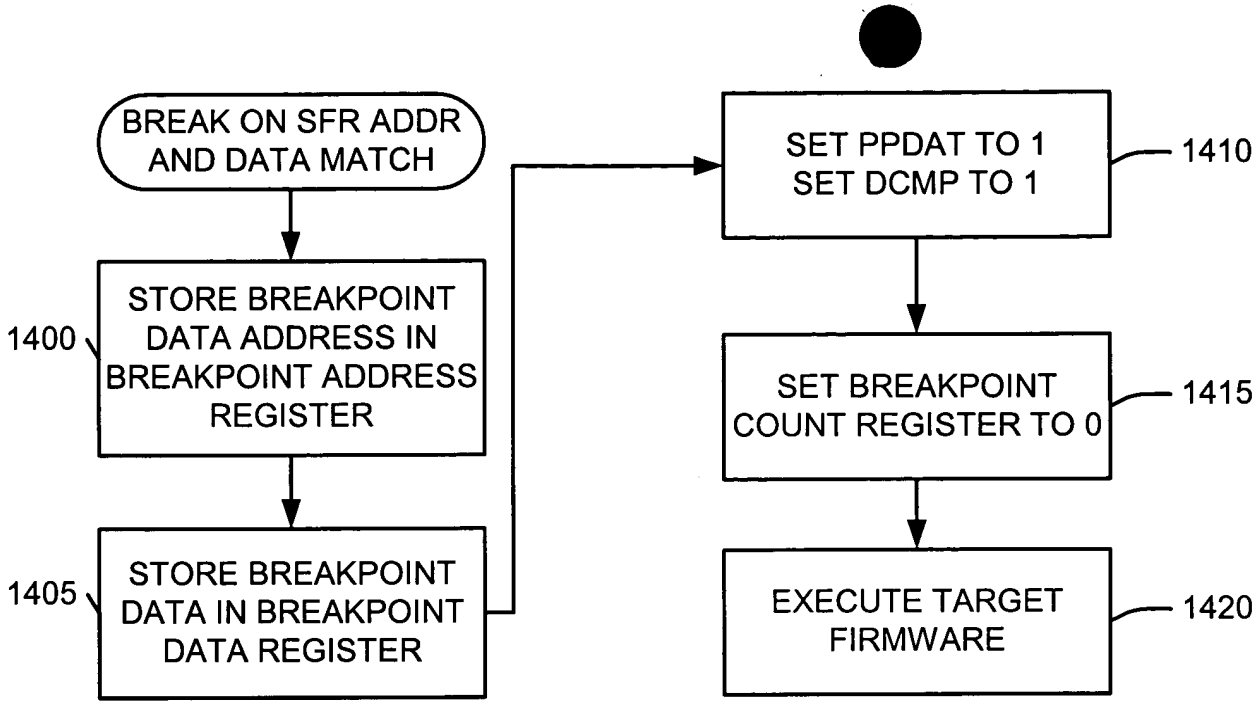
BREAK ON SFR ADDR AND DATA MATCH
STORE BREAKPOINT DATA ADDRESS IN BREAKPOINT ADDRESS REGISTER
1400
STORE BREAKPOINT DATA IN BREAKPOINT DATA REGISTER
1405
SET PPDAT TO 1
SET DCMP TO 1
1410
SET BREAKPOINT COUNT REGISTER TO 0
1415
EXECUTE TARGET FIRMWARE
1420

FIG. 14

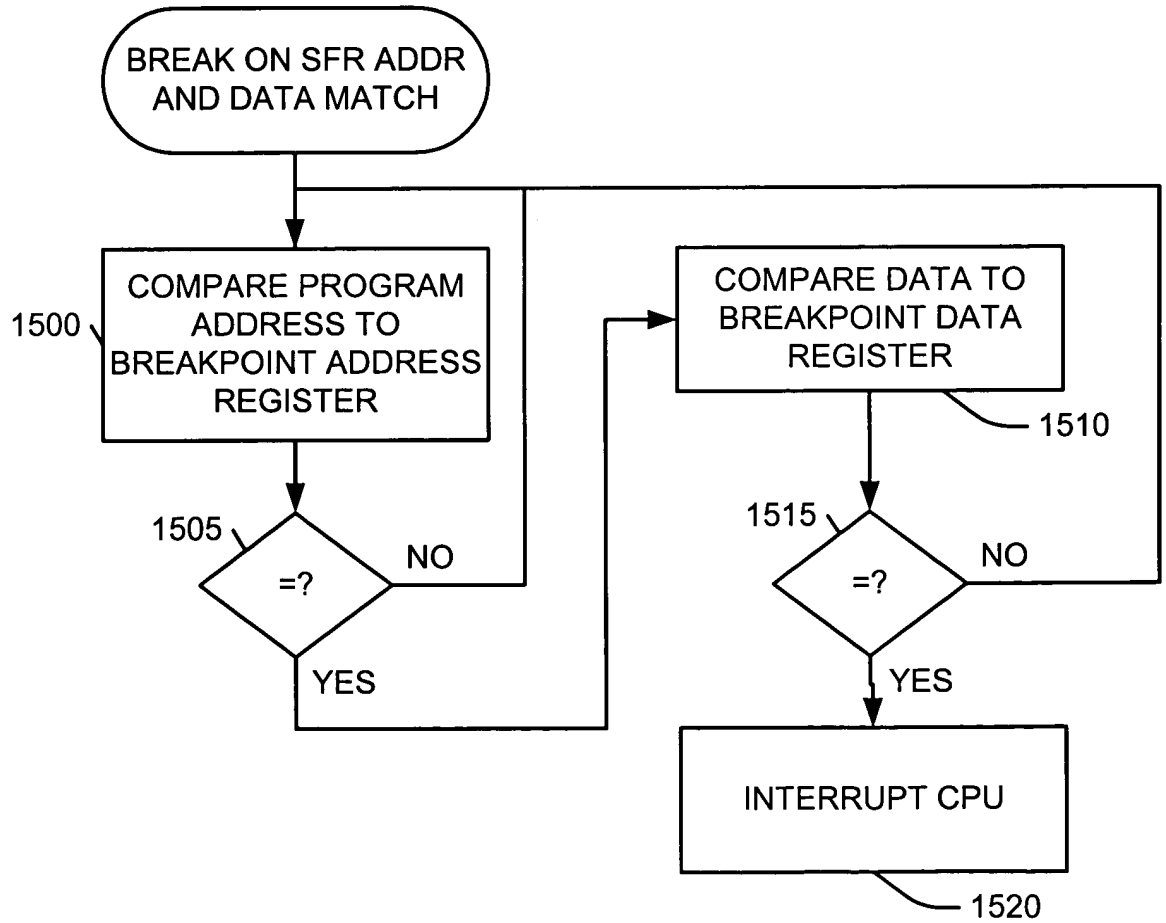
BREAK ON SFR ADDR AND DATA MATCH
COMPARE PROGRAM ADDRESS TO BREAKPOINT ADDRESS REGISTER
1500
1505
=?
NO
YES
COMPARE DATA TO BREAKPOINT DATA REGISTER
1510
1515
=?
NO
YES
INTERRUPT CPU
1520

FIG. 15

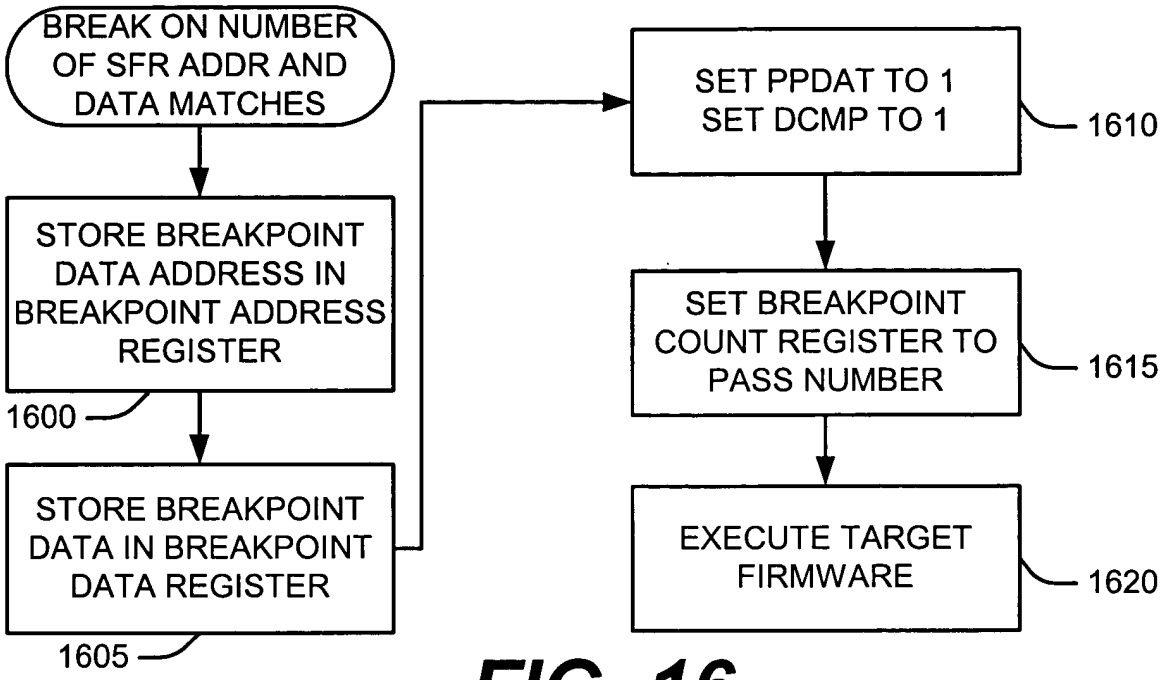
BREAK ON NUMBER OF SFR ADDR AND DATA MATCHES
STORE BREAKPOINT DATA ADDRESS IN BREAKPOINT ADDRESS REGISTER
1600
STORE BREAKPOINT DATA IN BREAKPOINT DATA REGISTER
1605
SET PPDAT TO 1
SET DCMP TO 1
1610
SET BREAKPOINT COUNT REGISTER TO PASS NUMBER
1615
EXECUTE TARGET FIRMWARE
1620

FIG. 16

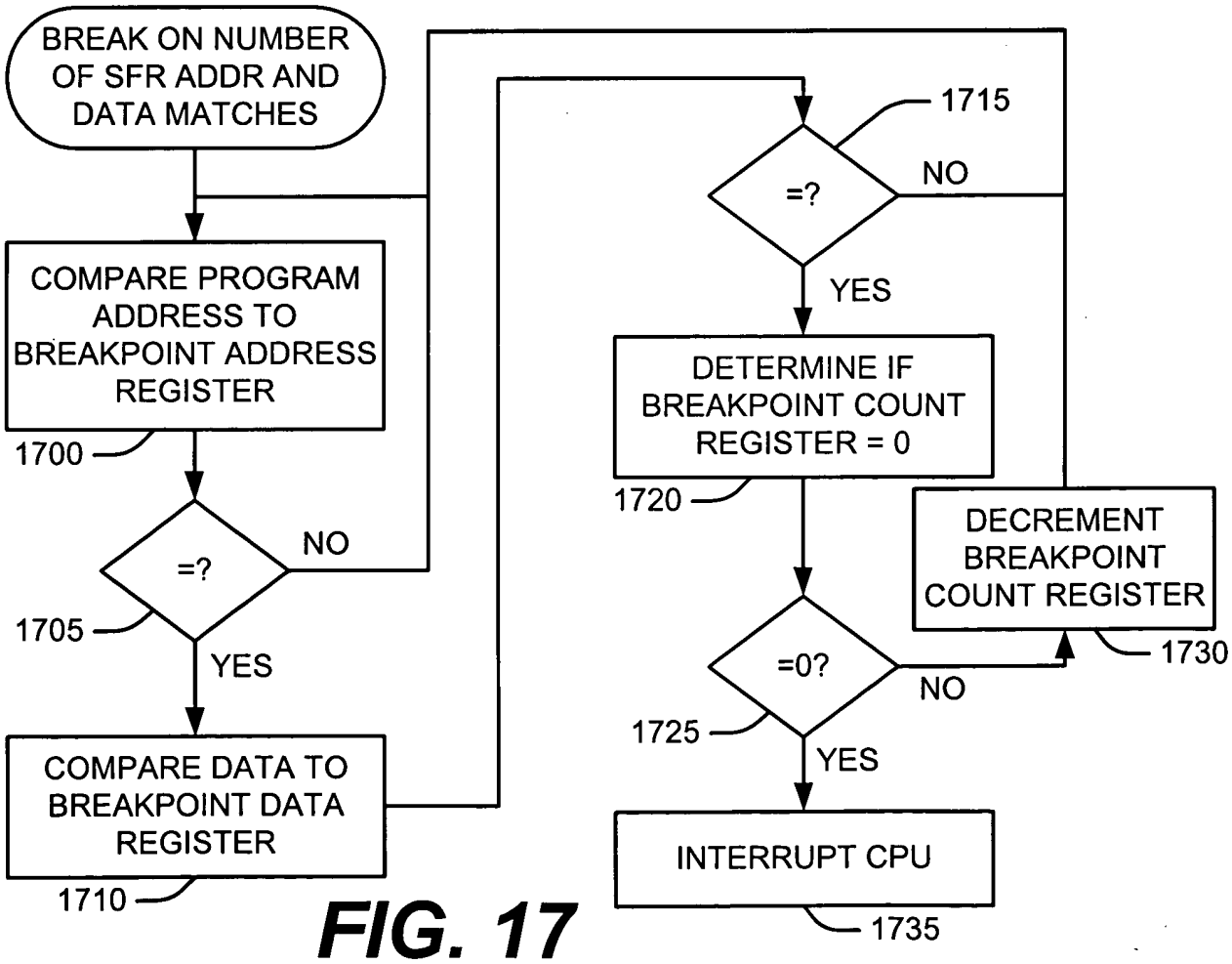
BREAK ON NUMBER OF SFR ADDR AND DATA MATCHES
COMPARE PROGRAM ADDRESS TO BREAKPOINT ADDRESS REGISTER
1700
=?
NO
1705
YES
COMPARE DATA TO BREAKPOINT DATA REGISTER
1710
1715
=?
NO
YES
DETERMINE IF BREAKPOINT COUNT REGISTER = 0
1720
DECREMENT BREAKPOINT COUNT REGISTER
1730
=0?
NO
1725
YES
INTERRUPT CPU
1735

FIG. 17